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Sunburn-related variables, secular trends of improved sun protection and short-term impact on sun attitude behavior in Italian primary schoolchildren

Analysis of the educational campaign "Il Sole Amico" ("The sun as a friend")

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Abstract

Sun protection early in life is an essential issue for primary prevention of skin cancers. The Il Sole per Amico was an educational campaign among 66 Italian primary schools. A total of 12,188 questionnaires were completed at baseline. Overall, 9.4% children reported >1 sunburn during the last year and 44.7% parents a use of sunlamps. Independent factors associated with sunburns were: age, lower level of parents' education, light eye and skin color, freckles, nevi on arms, intense sun exposure during the last year, sporadic use of sunscreens, and parental use of sunlamps. A total of 7280 (59.7%) questionnaires were completed at the end of the

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educational intervention. No significant difference was documented about behavior between the pre- and post-intervention periods. A significant reduction was instead found in both prevalence of recent sunburns and total number of sunburn episodes after comparison with the data obtained by identical questionnaire in the same geographic areas in the "Sole Si Sole No" project in 2001.

Abbreviations: CI = confidence intervals, GEE = generalized estimating equations, GISED = Group for Epidemiologic Research in Dermatology, IARC = the International Agency for Research on Cancer, NMSC = non-melanoma skin cancer, SD = standard deviations, UV = ultraviolet light.

Keywords: medical education, melanoma, primary prevention, sun protection

1. Introduction

The incidence of skin cancer has shown a persistent and progressive increase in fair-skinned populations over the last decades.[1,2] In particular, the growing incidence of melanoma and non-melanoma skin cancer (NMSC) among young adults is noteworthy.[3–5]

In Italy, invasive cutaneous melanoma ranks third in terms of incidence, among all malignant tumors in the population under the age of 50, both in males and females.[6] Ultraviolet light (UV) exposure is the most important environmental risk factor for melanoma and NMSC.[7,8] Solar and artificial UV radiations are classified as complete carcinogens by the International Agency for Research on Cancer (IARC).[8] Sun protection is an essential issue for primary prevention, and a crucial key point to decrease photocarcinogenesis and costly skin cancer treatments.[9,10]

There is a general consensus that excessive sun exposure and sunburns during early life play a primary etiopathogenetic role in the development of melanoma located in intermittently exposed areas, such as the trunk, while chronic sun exposure is causing melanoma, in older age, on chronically exposed areas such as the face. Interaction with constitutional variables which regulate cutaneous pigmentation should also be considered as risk factors.[11–12]

The importance of education to a correct sun exposure cannot be underestimated. Broad agreement exists that UV protection habits should be taught as part of routine preventive measures early in life.[13–16] A systematic review[17] concluded that educational approaches to increasing UV-protective behaviors were effective when implemented in primary schools and in recreational settings, and that insufficient evidence was available when implemented in other settings. The educational interventions should be submitted to a rigorous evaluation of impact, and should overcome the numerous physical, psychological and behavioral barriers.[18,19]

Unfortunately, there are limited data on the long-term impact of educational campaigns and on secular trends in sun protection behavior.[20]

From 2001 to 2004 the study *SoleSi-SoleNo* (Sun Yes or No) was carried out in Italy, coordinated by the Italian Group for Epidemiologic Research in Dermatology (GISED). The study was based on cluster randomization of a total of 122 schools, in 47 Italian cities. A total of 11,230 children of the second and third grades, were randomized to either a structured educational intervention or simple observation. The study did not document any effect of the educational intervention which involved children, their parents, and teachers, in a structured way, in reducing sunburns or improving sun protection behavior.[21]

At a distance of over 10 years, a nationwide educational program among schoolchildren, called Il Sole per Amico (The Sun as a Friend), targeting the same age sectors as the SoleSi-SoleNo project, was organized. The campaign was designed to retrieve a large set of data about skin phenotype, sun attitude behavior, sunburns and sunburns-related variables in the Italian pediatric population, and to test the potential impact of the intervention by comparing pre-campaign vs post-campaign attitudes while on the sun. Since identical questionnaires were used, the results were compared with the findings of the previous SoleSi-SoleNo program.

The objectives of this study were:

1. To assess factors influencing a history of sunburns and sun protection behavior in schoolchildren participating in the campaign;
2. To compare the baseline sun behavior data and reported sunburn rates, collected through the *SoleSi-SoleNo* campaign in September-October 2001 with identical data collected before the start of the *Il Sole per Amico* campaign in September-October 2015, to look for long term changes with reported sunburns and behavioral attitudes;
3. To test the potential short-term impact of the educational campaign *Il Sole per Amico* in a representative sample of Italian primary schoolchildren, comparing the data on sun exposure, ie, prevalence of sunburns and sun protection behavior, at baseline before the starting of the intervention and at a distance of about 6 months after completing the educational program.

2. Methods

The Il Sole per Amico was an educational campaign lasting for 1 year in a representative sample of primary schools from seven Italian regions with a total of 52 cities and 66 schools. Details about type of educational intervention, provided questionnaires, and applied statistical strategies are reported in Supplementary Material, http://links.lww.com/MD/D475. The study was approved by ethical committee of GISED.

2.1. Educational intervention

The educational intervention was structured into steps. In the first phase the principals/school officials/teachers of each institute in the participating regions were contacted in order to plan their participation in the study. Then, preparatory meetings were held with the heads of the schools adhering to the campaign, also involving a team of pedagogists. An educational kit was developed and made available to each school containing: a letter of presentation of the campaign, posters/flyers/handbills, a DVD with an educational video, and a series of illustrated educational materials for the pupils and their parents. A guide was given to the school teachers including information about the campaign, the skin, the importance of sun protection, and the

risks associated with excessive sun exposure. The guide also included ideas and indications for transmitting the basic concepts to the children and for organizing teaching activities on the topics of the campaign. A website was implemented with educational materials and a regular update about the campaign.

At least 3 hours during the school year were spent on the campaign themes. A 1 hour educational meeting was also held in each institute run by a dermatologist or trained IMI member on the correct mode of sun exposure, with the help of illustrative slides and the projection of an animated cartoon. At the end of the lesson, the pupils were given time to ask questions. IMI also launched an award among the schools for the production of a drawing, a limerick or a short novel, inspired by the contents of the campaign (https://www.melanomaimi.it/il-sole-per-amico-campagna-nazionale-di-prevenzione-del-melanoma.html).

2.2. Questionnaire

A questionnaire, for completion by parents, was distributed to schoolchildren before the start of the educational intervention, and a second one after the summer period, about 6 months after the end of the intervention, with the aim of assessing the impact of the campaign.

The questionnaire was structured to evaluate the degree of knowledge and correct mode of sun exposure and protection among the pupils and their parents.

It included demographic information on schoolchildren, that is, age, gender, height, and weight, information on parent education and occupation, phenotypic features of the children (ie, eye, hair, and skin color, nevus count on the arms), information on sun exposure in the children (sunburn episodes over lifetime and during the year preceding and following the intervention, vacations spent on seaside, mountains, and skiing holidays, information on the modalities of sun protection used (use of clothing, sunscreens and protection factor), and parents' use of sunlamps and knowledge about their use.

2.3. Statistical analysis

For descriptive purposes the categorical variables were represented by absolute frequencies and percentages, whereas the continuous variables by means and standard deviations (SD). The continuous variables were categorized by using clinically relevant cut-offs. In details, we have considered as nevus count cut-offs 0 to 10, 11 to 20, >20[22,23] and as sunburn during the previous year 0, 1 to 2, 3 or more. As concerns the level of sun protection adopted, a total score was calculated as the sum of the individual questions on: use of a hat, use of a T-shirt, use of sunglasses, use of sunscreens and protection factor used. The score for each question went from 0 (rarely/never/low) to 2 (always/high), for a total that ranged from 0 to 10.

In the univariate analysis, the Pearson X^2 test was used to determine statistically significant differences in the prevalence of sunburns among the different categories of the variables investigated at baseline and to evaluate significant differences among the prevalences in the studies *SoleSi-SoleNo* and *Il Sole per Amico*. The prevalences in the 2 studies were calculated together with their respective 95% confidence intervals (CI). Where necessary, the correlation among variables was investigated by means of the Pearson correlation coefficient (r).

All factors with P value <.15 identified in the univariate analysis were included in conditional logistic regression models taking into account the matching of the pupils per school and with a stepwise regression algorithm for the selection of the variables with significant independent effects. The effects were expressed in terms of odds ratio (OR) with respective 95% CI.

As concerns the analysis of the differences between baseline and the end of the educational campaign, generalized estimating equations (GEE) were employed, taking into account the matching of the pupils per school and with effects expressed in terms of OR and respective 95% CI. The GEE were employed both at the univariate and multivariable level, including as adjustment factors in the model: age, level of parents' education, episodes of intense sun exposure during the last year and skin color. All the tests were evaluated as statistically significant at P values <.05. Analyses were carried out using SPSS software v.20.0 (IBM Corp: Armonk, NY).

3. Results

3.1. Demographic data

In November 2015 (before starting the educational intervention), 12,188 questionnaires were filled in by the parents of the participating pupils (30.3% in the Northern Italy, 37.4% in Central Italy and 32.3% in Southern Italy and the Islands). The pupils in the sample had a mean age of 8.1 ± 1.2 years (mean ± SD) and 51.3% were female, with a similar distribution among the various geographic areas (Table 1). The level of education among parents was similar, with 45.8% of the fathers and 49.6% of the mothers having attended a secondary school; the fathers' most frequent professions were skilled worker/artisan (18.7%) and office workers (18.3%), while the mothers' ones were housewives (34.9%) and office workers (19.8%), with a variable distribution, depending on the geographic area.

Most of the pupils had dark brown (46.5%) or light brown eyes (18.1%), light (44.7%) or dark brown hair (31.2%) and fair (63.7%) or fairly dark skin (63.7%). Concerning the nevus count, 86.1% of the children had less than 10 nevi on their arms (mean 5 ± 6.4) and 18% presented ephelides, with similar phenotypic characteristics as to gender and geographic area.

Overall, 25.5% reported at least one sunburn during the child life (mean age at the first burn 5.7 ± 1.7 years) and 23.3% reported episodes of intense sun exposure during the previous year, with few differences per the origin geographic area; 9.4% of the children reported at least one episode of sunburn during the previous year, with a mean of 1.7 ± 3.2 burns among those who reported at least one. During the year preceding the interview, 75.6% of the children had spent holidays far from their place of residence: in details 87.7% of the latter had spent holidays at the seaside, 30.3% on the mountains, 12.4% had spent skiing holidays and 8.2% holidays in other places, with fairly ample differences among the different areas.

Concerning the behaviors during sun exposure, a total of 73.5% of the participants reported having used a hat sometimes or always, 73.6% having used a T-shirt, 54.2% sunglasses and 85.8% having always used sunscreens, with some differences as to gender and geographic location; 84.2% of the children used a high sun protection factor and only 1.1% a low factor. The mean total score of sun protection, given by the sum of the previous questions, was 6.2 ± 1.7.

As for the parents' use and knowledge about sunlamps, 44.7% of them stated they had used them, 17.9% thought they are useful to limit the risk of sunburn, 43.9% did not know what to answer

Table 1

General and demographic characteristics of the children and parents who participated in the study, by geographical area.

	Area						Total* (n = 12188)	
	Northern Italy (n = 3695)		Central Italy (n = 4559)		Southern Italy / Islands (n = 3934)			
	N	%	N	%	N	%	N	%
Gender								
M	1845	50.1%	2209	48.7%	1852	47.4%	5906	48.7%
F	1837	49.9%	2328	51.3%	2054	52.6%	6219	51.3%
Age (years)								
(*media, SD*)	*8.2*	*1.2*	*8.2*	*1.2*	*8.0*	*1.2*	*8.1*	*1.2*
6 or less	677	18.8%	878	19.8%	910	24.0%	2465	20.9%
7	887	24.7%	1034	23.3%	852	22.5%	2773	23.5%
8	925	25.7%	1186	26.8%	1015	26.8%	3126	26.5%
9 or more	1104	30.7%	1335	30.1%	1008	26.6%	3447	29.2%
Weight, kg								
(*media, SD*)	*29.0*	*7.1*	*29.5*	*7.3*	*29.1*	*7.6*	*29.2*	*7.4*
Height, cm								
(*media, SD*)	*130.3*	*10.0*	*130.5*	*10.3*	*128.2*	*11.0*	*129.7*	*10.5*
BMI, kg/m^2								
(*media, SD*)	*17.0*	*3.3*	*17.2*	*3.1*	*17.7*	*3.9*	*17.3*	*3.4*
Parent's education qualification (father)								
Primary school	242	6.7%	260	5.8%	270	7.0%	772	6.5%
Secondary school	927	25.5%	1209	27.1%	1381	35.7%	3517	29.4%
High school	1714	47.2%	2181	48.8%	1584	41.0%	5479	45.8%
Degree/post-degree	749	20.6%	817	18.3%	629	16.3%	2195	18.3%
Parent's education qualification (mother)								
Primary school	69	1.9%	76	1.7%	111	2.9%	256	2.1%
Secondary school	615	16.8%	807	18.0%	1169	30.1%	2591	21.5%
High school	1828	49.9%	2417	53.8%	1731	44.6%	5976	49.6%
Degree/post-degree	1150	31.4%	1195	26.6%	872	22.5%	3217	26.7%

BMI = Body Mass Index, SD = Standard Deviation.
* Sum may not add up to the total because of missing values.

on that, while 72.1% of the parents knew that minors are not allowed to use them.

3.2. Analysis of factors associated with sunburns at baseline

Table 2 presents the analysis of the factors associated with the prevalence of sunburn in children participating in the study during the year before the start of the educational program. In the multivariate analysis independent factors associated with sunburns were: age, with an upward trend from year to year; the parents' education (the education of the father and the mother were moderately correlated (r = 0.51), with greater risk associated with a lower level of education; eye color, with a slightly higher risk in those with brown/green eyes or light color eyes (blue/grey); skin color, with twice the risk for those with a very fair skin as compared with those with a darker skin; the presence of freckles; an high number of nevi on their arms, with a considerably higher risk for those who presented more than 20 nevi; episodes of intense sun exposure during the last year; the sporadic or no use of a hat during sun exposure; a sporadic use of sunscreens; the use of sunlamps by parents. In a separate analysis, the use of a hat during sun exposure was amply correlated with the total score of sun protection (r = 0.70) just like the use of other clothing and sun protections.

3.3. Impact of the educational intervention

Between September and November 2016, about 6 months after the conclusion of the educational intervention, a total of 7280 questionnaires (34.2% in the North, 30.9% in Central Italy, 35.0% In the South and Islands) were asked to be completed again by the parents of children participating in the educational program (59.7% of the children originally enrolled). The comparison of the pre- and post-intervention responses, is presented in Table 3. No significant difference was documented concerning the factors investigated with the exception of a trend toward a slightly increased use of a hat and sunglasses while on the sun. The rate of sunburns reported during the previous year was similar in the 2 study waves.

3.4. Comparison of baseline data of the SoleSi-SoleNo and Il Sole per Amico projects

Comparison of the baseline data for variables of interest between the studies *SoleSi-SoleNo* (2001–2004) and *Il Sole per Amico* (2015–2016) is reported in Table 4. Overall, a significant reduction was found in the prevalence of recent sunburns, from 13.8% (95% CI: 13.1–14.4) in 2001 to 9.4% (95% CI: 8.8–9.9) in 2015, and in the total number of sunburn episodes reported. Also the use of adequate protections during sun exposure increased in 2015 as compared with 2001, from 86.4% (95% CI: 85.7–87.0) to 93.1% (95% CI: 92.7–93.6), as well as the frequent use of a T-shirt from 19.7% (95% CI: 19.0–20.5) to 28.8% (95% CI: 28.0–29.6), although the regular use of the hat was reduced from 37.7% (95% CI: 36.8–38.6) to 23.3% (95% CI: 22.6–24.1). The regular use of sunscreens also increased in time from 71.1% (95% CI: 70.2–71.9) to 85.8% (95% CI: 85.1–86.4).

Table 2

Factors associated with the prevalence of sunburns during the last year among children participating in the study.

	N Tot.	Sunburns last year		Univariate analysis	Multivariate analysis[†]	
		N	%	*P*	OR (95% CI)	*P*
Gender						
M	5817	542	9.3%	.94		
F	6145	575	9.4%			
Age, years						
6 or less	2437	152	6.2%	<.001	1	
7	2725	197	7.2%		1.11 (0.89–1.39)	.36
8	3083	347	11.3%		1.57 (1.27–1.93)	<.001
9 or more	3409	384	11.3%		1.59 (1.29–1.96)	<.001
Father's education[‡]						
Primary school	745	105	14.1%	<.001	1.74 (1.33–2.29)	<.001
Secondary school	3457	356	10.3%		1.32 (1.08–1.62)	.007
High school	5421	465	8.6%		1.10 (0.91–1.32)	.34
Degree/post-degree	2178	183	8.4%		1	
Eye color						
Dark brown/Black	5950	476	8.0%	<.001	1	
Light brown	2148	198	9.2%		1.03 (0.85–1.23)	.79
Brown/dark green	1374	163	11.9%		1.22 (1.01–1.48)	.049
Green	906	87	9.6%		1.00 (0.78–1.29)	.97
Light blue/grey	1542	187	12.1%		1.24 (1.02–1.50)	.03
Hair color						
Dark brown/Black	4436	352	7.9%	<.001		
Light brown	5359	511	9.5%			
Reddish brown	371	46	12.4%			
Red	1731	199	11.5%			
Blonde	79	12	15.2%			
Skin color						
Very light	1189	181	15.2%	<.001	1.98 (1.56–2.52)	<.001
Light	7609	712	9.4%		1.33 (1.12–1.58)	.001
Dark	3155	229	7.3%		1	
Freckles						
None	9680	794	8.2%	<.001	1	
Few	1697	232	13.7%		1.30 (1.10–1.53)	.002
Many	437	82	18.8%		1.49 (1.15–1.93)	.002
Number of melanocytic nevi on upper limbs						
0 – 10	3259	253	7.8%	<.001	1	
11 – 20	926	122	13.2%		1.24 (1.04–1.48)	.02
>20	345	70	20.3%		1.53 (1.17–2.00)	.002
Intense sun exposure (last year)						
No / missing	9008	530	5.9%	<.001	1	
Yes	2749	570	20.7%		3.39 (2.98–3.85)	<.001
Hat use (last year)						
Rarely / never	3162	361	11.4%	<.001	1.30 (1.07–1.58)	.008
Sometimes	5996	566	9.4%		1.23 (1.03–1.46)	.02
Always	2792	193	6.9%		1	
T-shirt use (last year)						
Rarely / never	3117	301	9.7%	.14		
Sometimes	5293	516	9.7%			
Always	3404	291	8.5%			
Sunglasses use (last year)						
Rarely / never	5417	578	10.7%	<.001		
Sometimes	5265	452	8.6%			
Always	1160	81	7.0%			
Sunscreen use (last year)						
Rarely / never	365	30	8.2%	<.001	0.88 (0.50–1.54)	.66
Sometimes	1316	166	12.6%		1.31 (1.08–1.59)	.007
Always	10235	917	9.0%		1	
Sun protection factor used (last year)						
Low	124	17	13.7%	.003	1.69 (0.97–2.94)	.06
Medium	1740	196	11.3%		1.19 (0.99–1.42)	.06
High	9909	889	9.0%		1	
Total score protection[§]						

(*continued*)

Table 2

(continued).

	N Tot.	Sunburns last year		Univariate analysis	Multivariate analysis[†]	
		N	%	*P*	OR (95% CI)	*P*
0 – 5	3834	428	11.2%	<.001		
6 – 7	5334	507	9.5%			
8 – 10	2790	185	6.6%			
Sunbed used by parents						
No	6596	549	8.3%	<.001	1	
Yes	5354	567	10.6%		1.18 (1.04–1.35)	.01

CI = Confidence Interval, OR = odds ratio, *P* = *P* value.

[*] Differences in prevalence of sunburns between categories was evaluated by X^2 test.

[†] Results are obtained by conditional logistic regression taking into account matching by school, with backward selection of independent variables.

[‡] Parent's education is widely correlated (r = 0.51).

[§] Total score is the sum of single questions on use of hat, t-shirt, sunglasses, sunscreen, sun protection factor. The score of each question goes from 0 (rarely/ never/ low) to 2 (always/ high).

4. Discussion

The project "*Il Sole per Amico*" allowed to obtain new evidence related to behavior while on the sun of young Italian schoolchildren and to identify factors associated with an increased risk of reporting sunburns. On the other hand, the study failed to document a significant short-term change in several indicators of UV protection by the educational program. These negative results confirm the lack of an impact from a similar short-term educational intervention the *SoleSi-SoleNo* program, conducted in the years 2001 to 2004. Interestingly, the comparison of data at baseline of the *Il Sole per Amico* program with those from the *SoleSi-SoleNo* project, collected in 2015 and 2001, respectively, documented a decrease by about the 4.4% in the prevalence of

Table 3

Comparison of the main results of the educational intervention.

	Pre-intervention		Post-intervention		Univariate analysis*		Multivariate analysis[†]	
	N	%	N	%	OR (95% CI)	*P*	OR (95% CI)	*P*
Intense sun exposure								
No / missing	9131	76.7%	5276	74.4%	1		1	
Yes	2771	23.3%	1818	25.6%	1.08 (1.01–1.15)	.02	1.04 (0.98–1.10)	.17
Sunburn								
No / missing	10895	90.6%	6460	89.7%	1		1	
Yes	1124	9.4%	740	10.3%	1.06 (0.99–1.14)	.08	0.99 (0.93–1.06)	.80
Hat use								
Rarely / never	3182	26.5%	2443	34.0%	1		1	
Sometimes	6020	50.2%	3506	48.8%	0.86 (0.82–0.91)	<.001	0.90 (0.85–0.95)	<.001
Always	2801	23.3%	1232	17.2%	0.75 (0.69–0.82)	<.001	0.84 (0.76–0.92)	<.001
T-shirt use								
Rarely / never	3130	26.4%	1939	27.2%	1		1	
Sometimes	5310	44.8%	3138	44.0%	0.98 (0.92–1.05)	.59	0.97 (0.90–1.03)	.32
Always	3413	28.8%	2050	28.8%	1.00 (0.91–1.10)	.96	0.96 (0.87–1.06)	.43
Sunglasses use								
Rarely / never	5443	45.8%	3178	44.6%	1		1	
Sometimes	5275	44.4%	3161	44.4%	1.02 (0.98–1.07)	.26	1.03 (0.99–1.08)	.16
Always	1164	9.8%	780	11.0%	1.09 (1.01–1.17)	.02	1.13 (1.05–1.22)	.001
Sunscreen use								
Rarely / never	378	3.2%	252	3.5%	1		1	
Sometimes	1321	11.0%	978	13.7%	1.06 (0.95–1.18)	.32	1.10 (0.99–1.23)	.08
Always	10256	85.8%	5926	82.8%	0.92 (0.80–1.05)	.21	1.10 (0.98–1.24)	.10
Sun protection factor used								
Low	125	1.1%	82	1.2%	1		1	
Medium	1742	14.8%	1157	16.4%	0.97 (0.81–1.16)	.72	1.07 (0.87–1.33)	.51
High	9932	84.2%	5818	82.4%	0.91 (0.75–1.10)	.35	1.19 (0.94–1.50)	.15
Total score protection[‡]								
0–5	3861	32.2%	2590	36.0%	1		1	
6–7	5345	44.6%	3170	44.1%	0.95 (0.90–0.99)	.03	1.01 (0.96–1.07)	.59
8–10	2791	23.3%	1433	19.9%	0.88 (0.81–0.96)	.003	0.99 (0.90–1.08)	.74

CI = Confidence Interval, OR = odds ratio, *P* = *P* value.

[*] Results are obtained by GEE models taking into account matching by school.

[†] Results are obtained by GEE models taking into account matching by school adjusting for age, educational level of parents, intense sun exposure in during the previous year and skin color.

[‡] Total score is the sum of single questions on use of hat, t-shirt, sunglasses, sunscreen, sun protection factor. The score of each question goes from 0 (rarely/ never/ low) to 2 (always/ high).

Table 4

Comparison of the prevalence data between *SoleSi-SoleNo* (2001–2004) and *Il Sole per Amico* (2015–2016).

	SolesiSoleno (n = 11230)	Sole Amico (n = 12188)
	Pr (95% CI)*	Pr (95% CI)*
Sunburns (last year) number	13.8% (13.1–14.4)	9.4% (8.8–9.9)
0	82.1% (81.3–82.8)	89.3% (88.7–89.8)
1–2	10.2% (9.6–10.8)	6.3% (5.9–6.7)
3+	1.6% (1.3–1.8)	0.6% (0.5–0.8)
Sunprotection use (last year)	86.4% (85.7–87.0)	93.1% (92.7–93.6)
Hat use		
Rarely / never	20.9% (20.2–21.7)	26.5% (25.7–27.3)
Sometimes	39.4% (38.5–40.3)	50.2% (49.3–51.1)
Always	37.7% (36.8–38.6)	23.3% (22.6–24.1)
T-shirt use		
Rarely / never	36.5% (35.6–37.4)	26.4% (25.6–27.2)
Sometimes	41.8% (40.9–42.7)	44.8% (43.9–45.7)
Always	19.7% (19.0–20.5)	28.8% (28.0–29.6)
Sunscreen use		
Rarely / never	10.0% (9.5–10.6)	3.2% (2.9–3.5)
Sometimes	16.9% (16.2–17.6)	11.0% (10.5–11.6)
Always	71.1% (70.2–71.9)	85.8% (85.1–86.4)

CI = Confidence interval, Pr = Prevalence.

* Significant differences in prevalence between 2 studies were evaluated by Pearson X^2 test (P value <.001).

reported sunburns and an overall improvement of almost all the indicators adopted for an adequate sun protection behavior. In spite of this overall improvement, a lifetime history of sunburns was still reported by 25.5% of participating children, with a mean age at the first burn of 5.7 ± 1.7 years) this percentage appears to be exceedingly high considering that about 85% stated they always used high protection sunscreens.

Several variables influenced a positive history of sunburns at baseline, partly related with the children phenotype and partly connected with parent's education and behavior. The study allowed to identify several factors associated with sunburns in schoolchildren on which action could be taken. Among these, besides the use of clothing, in particular a hat, which seems to be a surrogate of a global measure of sun protection, and the sporadic use of sunscreens, key factors were the parents' level of education, as well as their attitude to use sunlamps. Noteworthy, 44.7% of the parents stated they had used tanning beds.

All in all, these data suggest that it is possible to identify children at higher risk for sunburns who may be a specific target for educational campaigns, and that an intensive educational intervention conducted over a short period of time is unable to bring about significant changes in sun protection behavior when these changes are measured close to the end of the intervention. The decrease in sunburns and the improvement in several indicators of sun protection behavior, documented in 2015 as compared with 2001, suggest that the awareness at the population concerning the danger of the exposure of children to UV has increased over the last 10 years. This observation points to the need for the adoption of less intensive but more continuous educational interventions planned over a longer time span. For the future, educational interventions should also be better targeted to groups at higher risk and involve more actively the children's parents.

Our study has some limitations. Among these is the loss of subjects providing data after the completion of the intervention (about 40%). This may have substantially reduced the power of the study also introducing a possible selection bias; the preferable use of web-based resources with access driven to each participant through specific individual credentials could overcome this bias in future projects. Moreover, the intervention, as well as the subsequent evaluation, could have been too short to significantly influence the variables under study. It should be noted that a trend toward increasing rates of suburbs during the previous year, with increasing age, was documented. Hence, a pre-and post-intervention comparison is probably not the best way to measure improvement in sun exposure modalities.

Changing behavior is a difficult task and there is a need for a continuous reinforcement of the messages. Knowledge of dangers does not necessarily translate into behavioral changes, with people slowing moving, according to the model proposed by Prohaska, from a pre-contemplation, to a contemplation stage, to action.[24]

The "*Sole per Amico*" study failed to observe marked behavioral changes shortly after the educational program. Indeed, no difference in sun exposure, sunburns and use of sunscreens was found after the intervention. This was not the case for the nationwide French and German studies of Sancho-Garnier et al[25] and Stover et al.[24] They both demonstrated an early improvement in children's attitudes and behaviors. Others, conversely, did not observe any early and significantly change in sun-protective habits.[27,28] Among adolescents and students an intensive education campaign (1998–2004) in the US was reported to obtain only a modest change in sun exposure.[29] Failures of melanoma education efforts have been also noted in other high-risk countries.[30]

Our data suggest that there can be a "natural" secular trend in increasing the level of children' awareness on the need to avoid sunburns. This is probably the cumulative result of a number of low-intensity but continuous educational messages from multiple sources. Probably, the most effective initiatives are those that combine public health education campaigns with policy and environmental strategies that are integrated across state, regional and local levels. In Australia, for example, effective education and awareness initiatives have been centered on school health programs, sport and recreation groups, workplaces, and general practitioners.[31] However, a long term study from Australia reported an early improvement followed by a stabilization and – after 2 decades – a decline in sun protection habits in the same cohort.[32] Some researchers have confirmed the importance of involving parents and caregivers in educational efforts.[33,34] Sociodemographic features, such as parental education and larger family dimension, may be related with insufficient sun protection methods, and need consideration.[34]

In conclusion, the present study has shown that developing a suitable strategy for correct sun exposure is a difficult and complicated task. Several demographic and behavioral factors were confirmed as related with sunburns in children. Parents attitude toward UV light exposure also played an important role. We did not document a relevant impact of a short-term educational intervention on sun exposure. However, a secular trend with improved behavior and reduced sunburn rates was documented over almost two decades by the comparison within the "Sole sì sole no" and the "sole per amico" campaign. Based on these results, future studies should analyze the impact of low intensity and persistent multi-level interventions by a variety of stakeholders as cost-effective strategy with positive changes in sun-related behavior and attitudes.

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